Lecture 2 - Demand and Supply

ECON 3070 - Intermediate Microeconomic Theory

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Overview

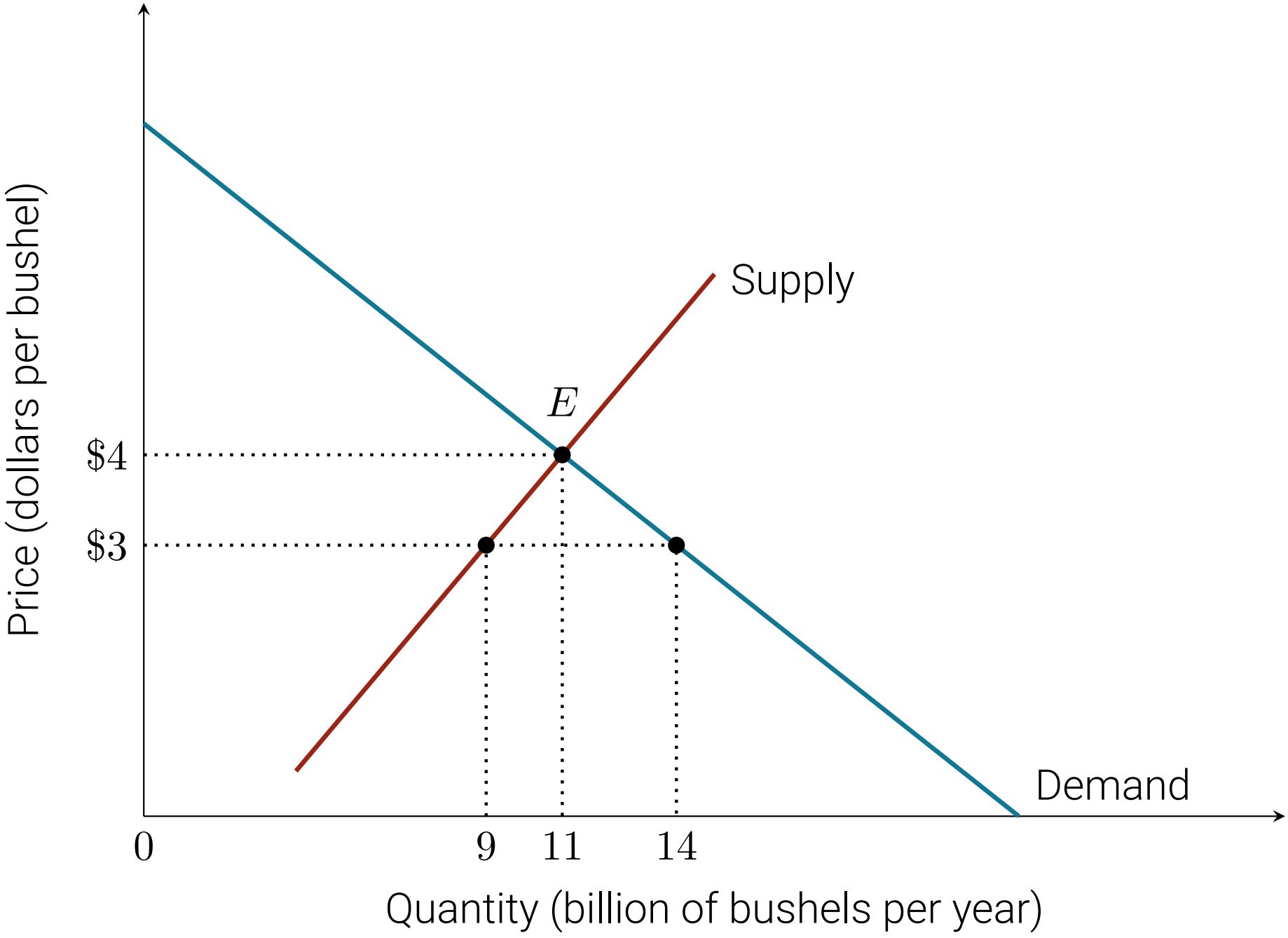
In this lecture, we will review the following:

1. Supply and demand
2. Market equilibrium, both graphically and numerically
3. Elasticities

Demand, Supply and Market Equilibrium

A *perfectly competitive market* comprises a large number of buyers and sellers.

- Buyers and sellers act as *price takers* in these markets.
- Sellers all produce identical products.


Price (dollars per bushel)
Supply
E
$4
$3
Demand
0
9
11
14
Quantity (billion of bushels per year)

Demand, Supply and Market Equilibrium

Try It Yourself

Which of the following would most likely be considered a perfectly competitive market?

- The craft beer industry
- The grill industry
- The soybean industry

Demand Curves

The market demand curve tells us the quantity of corn that buyers are willing to purchase at different prices.

- **Derived demand** is derived from the production and sale of other goods. (*e.g.* computer chips are not purchased directly, but are used as an input for computers/phones.)
- **Direct demand** is demand that comes directly from consumers.

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The market demand curve tells us the quantity of corn that buyers are willing to purchase at different prices.

- **Derived demand** is derived from the production and sale of other goods. (*e.g.* computer chips are not purchased directly, but are used as an input for computers/phones.)
- **Direct demand** is demand that comes directly from consumers.

The **law of demand** is the inverse relationship between the price of a good and the quantity demanded of that good.

Calculating Quantity Demanded

Try It Yourself

Suppose that the demand curve for Chaco's sandals in Boulder is given by $Q^D_{chaco} = 40,000 - 500P_{chaco}$. What is the quantity demanded of Chaco's if the price is $\$60$?

Aggregating Demand

Consider if you have two consumers of a good. Each consumer's demand curve tells us *at a given price*, how many units will they buy.

How do we figure out the aggregate demand curve?

Aggregating Demand

Consider if you have two consumers of a good. Each consumer's demand curve tells us *at a given price*, how many units will they buy.

How do we figure out the aggregate demand curve?

- *At a given price*, add up each consumer's quantity demanded

Aggregating Demand

Demand cannot be negative. So when we state demand as

$$Q^D_{chaco} = 40,000 - 500P_{chaco}$$

we are actually saying

$$Q^D_{chaco} = \begin{cases} 40,000 - 500P_{chaco} & \text{if } P_{chaco} \leq 80 \\ 0 & \text{otherwise.} \end{cases}$$

Aggregating Demand

Example

Suppose we have two consumers, A and B. Suppose that

$$Q_A^D = \begin{cases} 20 - 2P & \text{if } P \leq 10 \\ 0 & \text{otherwise.} \end{cases} \qquad Q_B^D = \begin{cases} 21 - 3P & \text{if } P \leq 7 \\ 0 & \text{otherwise.} \end{cases}$$

What's the aggregate demand curve?

Aggregating Demand

Example

$$Q_A^D = \begin{cases} 20 - 2P & \text{if } P \leq 10 \\ 0 & \text{otherwise.} \end{cases} \qquad Q_B^D = \begin{cases} 21 - 3P & \text{if } P \leq 7 \\ 0 & \text{otherwise.} \end{cases}$$

At a price of $P \leq 7$, both consumers will purchase good, so aggregate demand is given by

$$Q_{mkt}^D = Q_A^D + Q_B^D = (20 - 2P) + (21 - 3P) = 41 - 5P$$

Aggregating Demand

Example

$$Q_A^D = \begin{cases} 20 - 2P & \text{if } P \leq 10 \\ 0 & \text{otherwise.} \end{cases} \qquad Q_B^D = \begin{cases} 21 - 3P & \text{if } P \leq 7 \\ 0 & \text{otherwise.} \end{cases}$$

At a price $7 < P \leq 10$, only consumer A will consume ($Q_B^D = 0$), so aggregate demand is given by

$$Q_{mkt}^D = Q_A^D + Q_B^D = (20 - 2P) + 0 = 20 - 2P$$

Aggregating Demand

Example

$$Q_A^D = \begin{cases} 20 - 2P & \text{if } P \leq 10 \\ 0 & \text{otherwise.} \end{cases} \qquad Q_B^D = \begin{cases} 21 - 3P & \text{if } P \leq 7 \\ 0 & \text{otherwise.} \end{cases}$$

At a price $P > 10$, no one consumes anything, so

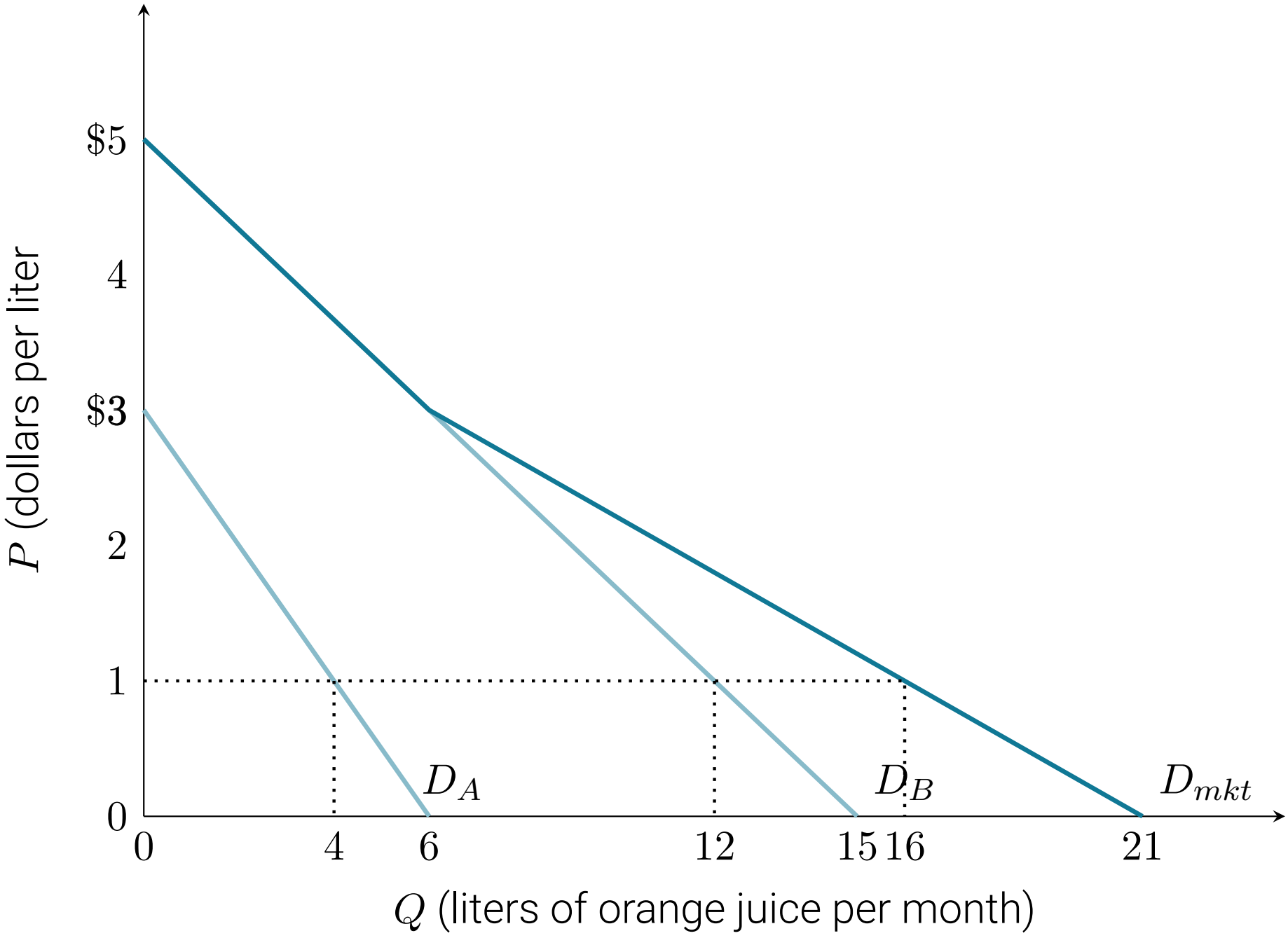
$$Q_{mkt}^D = Q_A^D + Q_B^D = 0 + 0 = 0$$

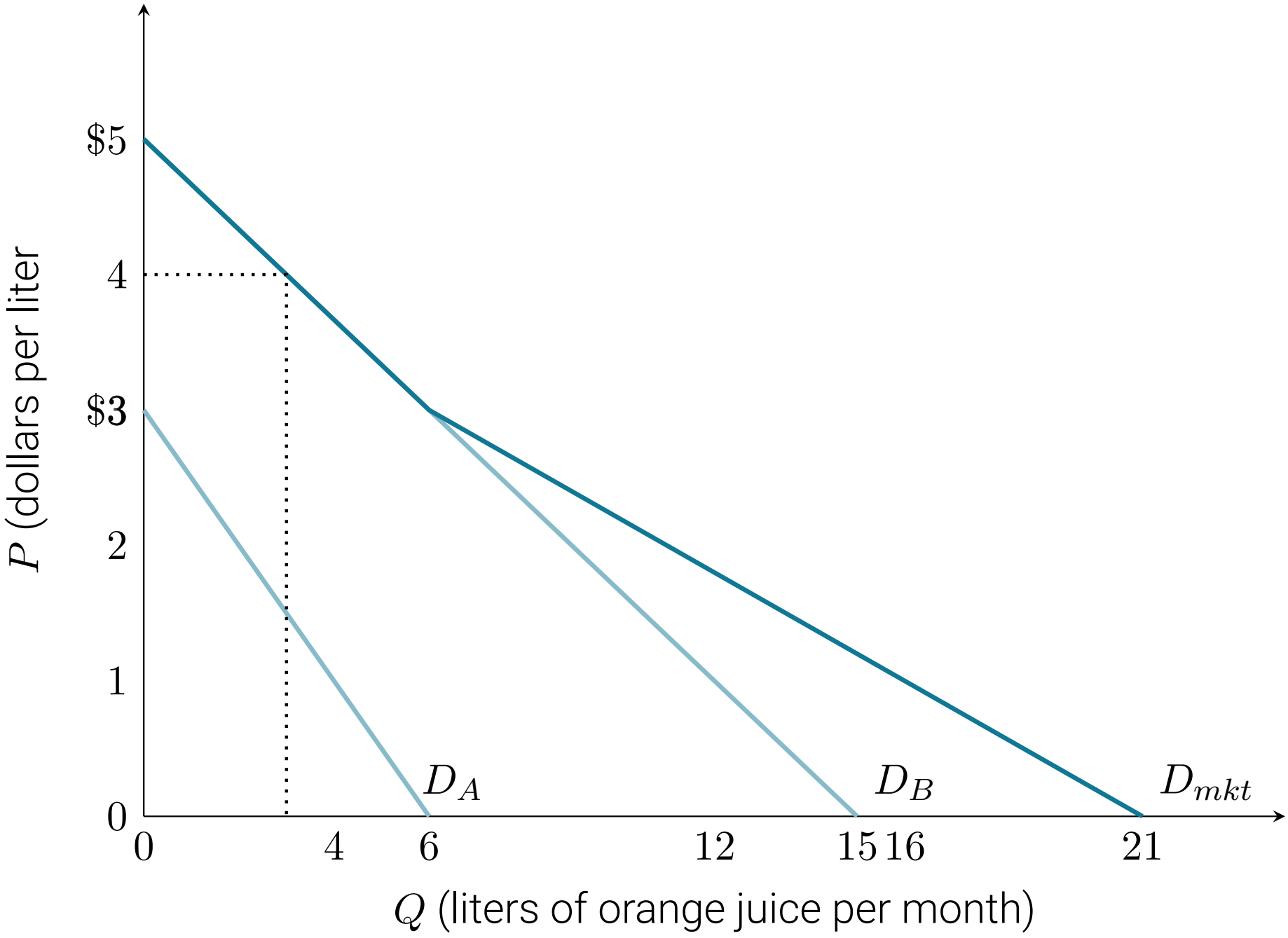
Aggregating Demand

Example

Putting this together

$$Q^D_{mkt} = \begin{cases} 41 - 5P & \text{if } P \leq 7 \\ 20 - 2P & \text{if } 7 < P \leq 10 \\ 0 & \text{otherwise.} \end{cases}$$


$5
4
$3
2
1
0
P (dollars per liter
D_A
D_B
D_mkt
0
4
6
12
15
16
21
Q (liters of orange juice per month)


$5
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1
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P (dollars per liter
D_A
D_B
D_mkt
0
4
6
12
15
16
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Q (liters of orange juice per month)

Try It Yourself

Find the aggregate demand curve:

$$Q_A^D = \begin{cases} 30 - 6P & \text{if } P \leq 5 \\ 0 & \text{otherwise.} \end{cases} \qquad Q_B^D = \begin{cases} 32 - 4P & \text{if } P \leq 8 \\ 0 & \text{otherwise.} \end{cases}$$

Supply Curves

The market supply curve tells us the quantity of a product that producers are willing to sell at different prices.

- The **law of supply** is the *positive* relationship between the price of a good and the quantity supplied of that good.

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- The **law of supply** is the *positive* relationship between the price of a good and the quantity supplied of that good.

Quantity supplied is affected by not just market price. For example, the prices of **factors of production**, or resources used in the production of the good, affect the quantity supplied.

Calculating Quantity Supplied

Try It Yourself

Suppose that the supply curve for Chaco's sandals in Boulder is given by $Q^S_{chaco} = -8,000 + 300P_{chaco}$. What is the quantity supplied of Chaco's if the price is $\$50$?

Aggregating Supply

Consider if you have two producers of a good. Each producer's supply curve tells us *at a given price*, how many units will they sell.

How do we figure out the aggregate supply curve?

Aggregating Supply

Consider if you have two producers of a good. Each producer's supply curve tells us *at a given price*, how many units will they sell.

How do we figure out the aggregate supply curve?

- *At a given price*, add up each producer's quantity supplied

Aggregating Supply

Suppose we have two producers, A and B. Suppose that

$$Q_A^S = \begin{cases} 4P - 12 & \text{if } P \geq 3 \\ 0 & \text{otherwise.} \end{cases} \qquad Q_B^S = \begin{cases} 3P - 15 & \text{if } P \geq 5 \\ 0 & \text{otherwise.} \end{cases}$$

At a price of $P \geq 5$, both producers will supply, so supply is given by

$$Q_{mkt}^S = Q_A^S + Q_B^S = (4P - 12) + (3P - 15) = 7P - 27$$

Aggregating Supply

Suppose we have two producers, A and B. Suppose that

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At a price $3 \leq P < 5$, only producer A will produce ($Q_B^S = 0$), so supply is given by

$$Q_{mkt}^S = Q_A^S + Q_B^S = (4P - 12) + 0 = 4P - 12$$

Aggregating Supply

Suppose we have two producers, A and B. Suppose that

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At a price $P < 3$, no one produces anything, so

$$Q_{mkt}^S = Q_A^S + Q_B^S = 0 + 0 = 0$$

Aggregating Supply

Putting this together, we have

$$Q^S_{mkt} = \begin{cases} 7P - 27 & \text{if } P \geq 5 \\ 4P - 12 & \text{if } 3 < P \leq 5 \\ 0 & \text{otherwise.} \end{cases}$$

Try It Yourself

Find the aggregate supply curve:

$$Q_A^S = \begin{cases} 5P - 25 & \text{if } P \geq 5 \\ 0 & \text{otherwise.} \end{cases} \qquad Q_B^S = \begin{cases} 3P - 24 & \text{if } P \geq 8 \\ 0 & \text{otherwise.} \end{cases}$$

Market Equilibrium

Equilibrium occurs at the price where quantity supplied equals quantity demanded. *Why is this an equilibrium?*

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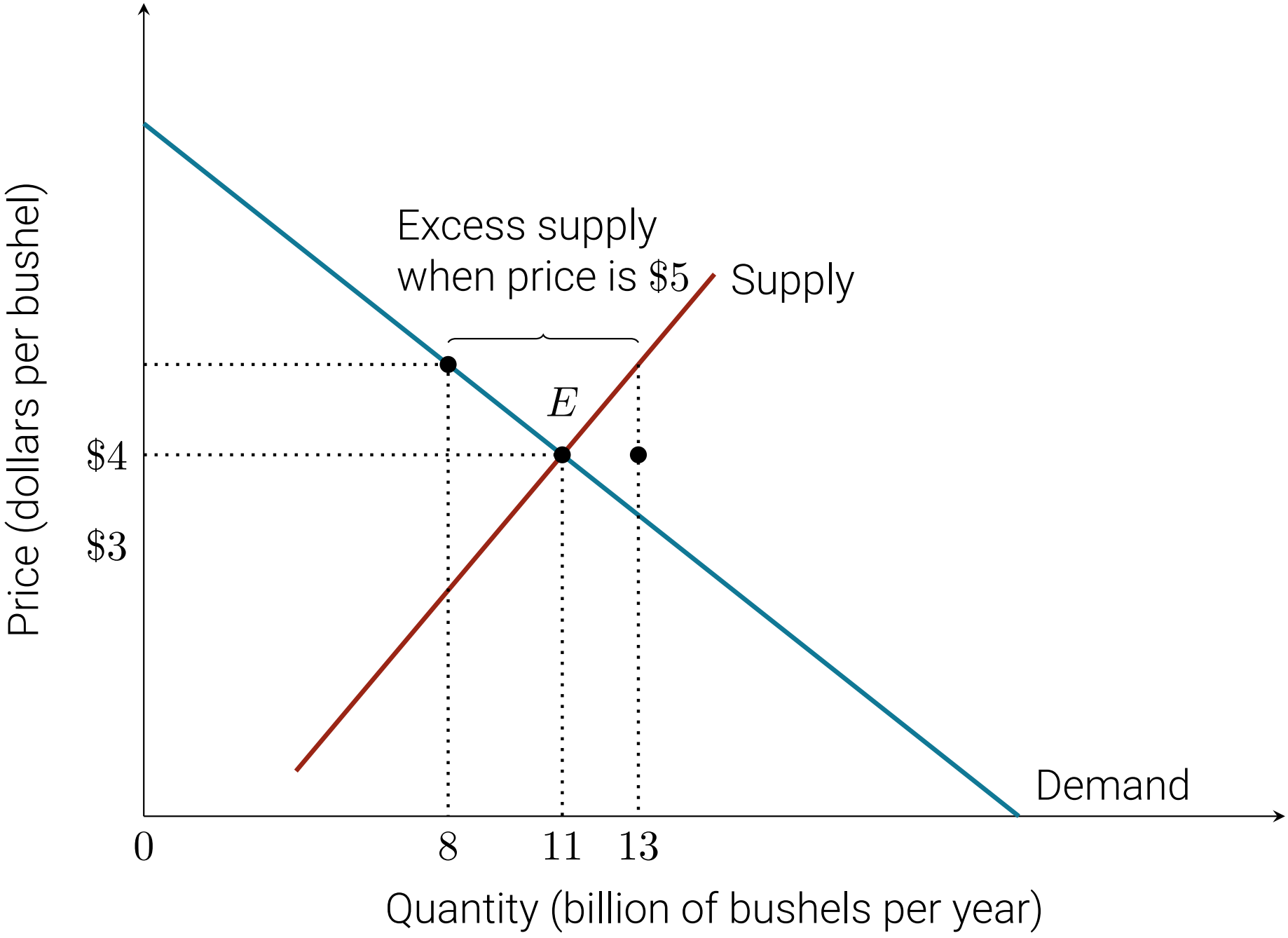
- What would happen if the price is $5 per bushel?


Price (dollars per bushel)
Excess supply
when price is $5
Supply
E
$4
$3
Demand
0
8
11
13
Quantity (billion of bushels per year)

Market Equilibrium

Equilibrium occurs at the price where quantity supplied equals quantity demanded. *Why is this an equilibrium?*

- What would happen if the price is $5 per bushel? Excess supply will lead to a price war by suppliers.
  - → The price will fall until all units are sold.

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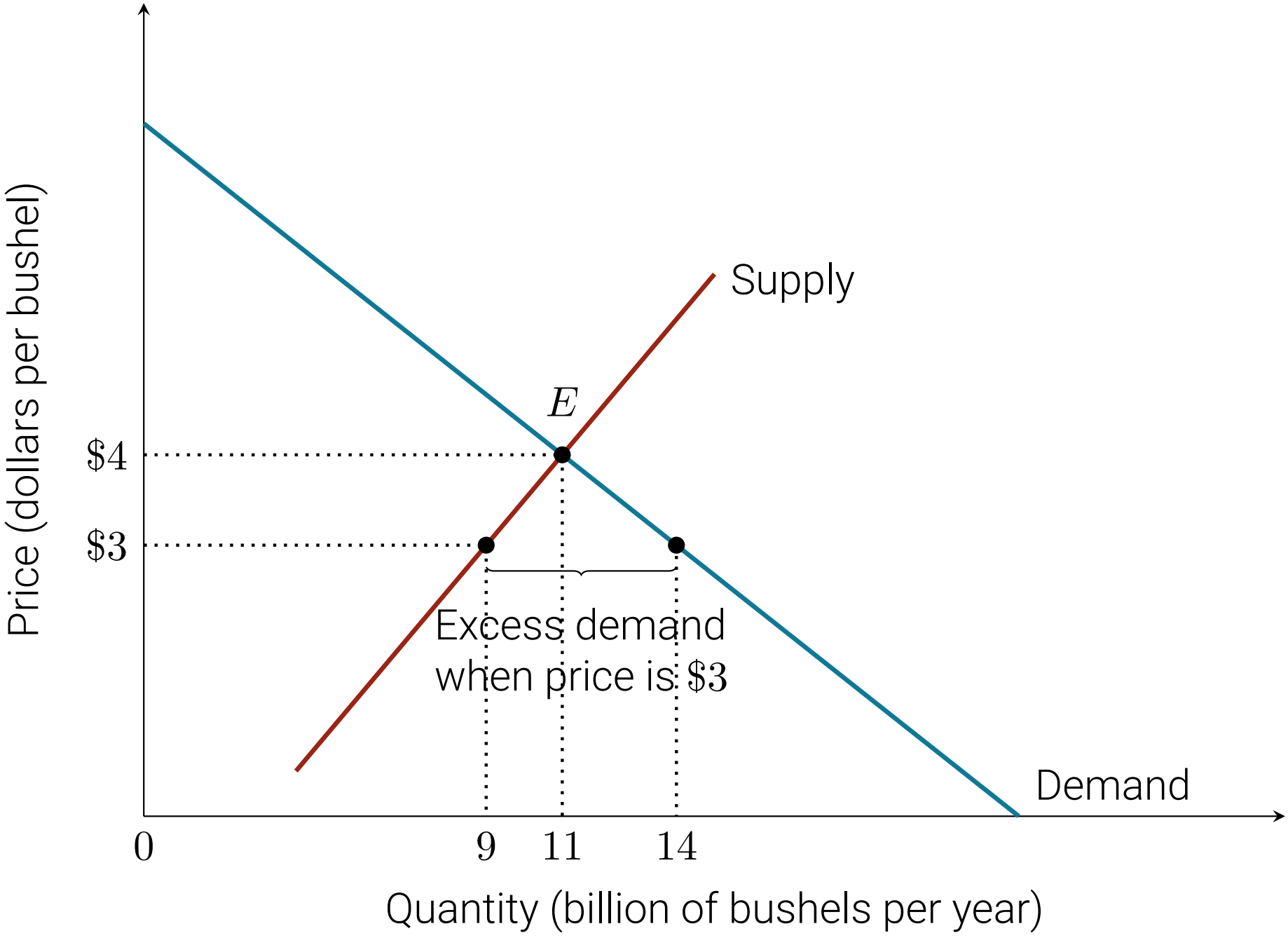
  - → The price will fall until all units are sold.
- What would happen if the price is $3 per bushel?


Price (dollars per bushel)
Supply
E
$4
$3
Excess demand
when price is $3
Demand
0
9
11
14
Quantity (billion of bushels per year)

Market Equilibrium

Equilibrium occurs at the price where quantity supplied equals quantity demanded. *Why is this an equilibrium?*

- What would happen if the price is $5 per bushel? Excess supply will lead to a price war by suppliers.
  - → The price will fall until all units are sold.
- What would happen if the price is $3 per bushel? Excess demand will lead to a bidding war by consumers.
  - → The price will rise until all consumers are satisified.

Market Equilibrium

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- What would happen if the price is $3 per bushel? Excess demand will lead to a bidding war by consumers.
  - → The price will rise until all consumers are satisified.

Therefore, $4 is an equilibrium because, absent any external forces, the price will not change.

Calculating Market Equilibrium

Try It Yourself

Suppose that the supply curve for Chaco's sandals in Boulder is given by $Q^S_{chaco} = -8,000 + 300P_{chaco}$, and the demand curve is $Q^D_{chaco} = 40,000 - 500P_{chaco}$. What is the equilibrium price of Chaco's?

Shifts in Supply and Demand

Previously, we assumed that all factors other than price were fixed. But suppose that consumer incomes increase. *What happens to the demand curve?*

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Shifts in Supply and Demand

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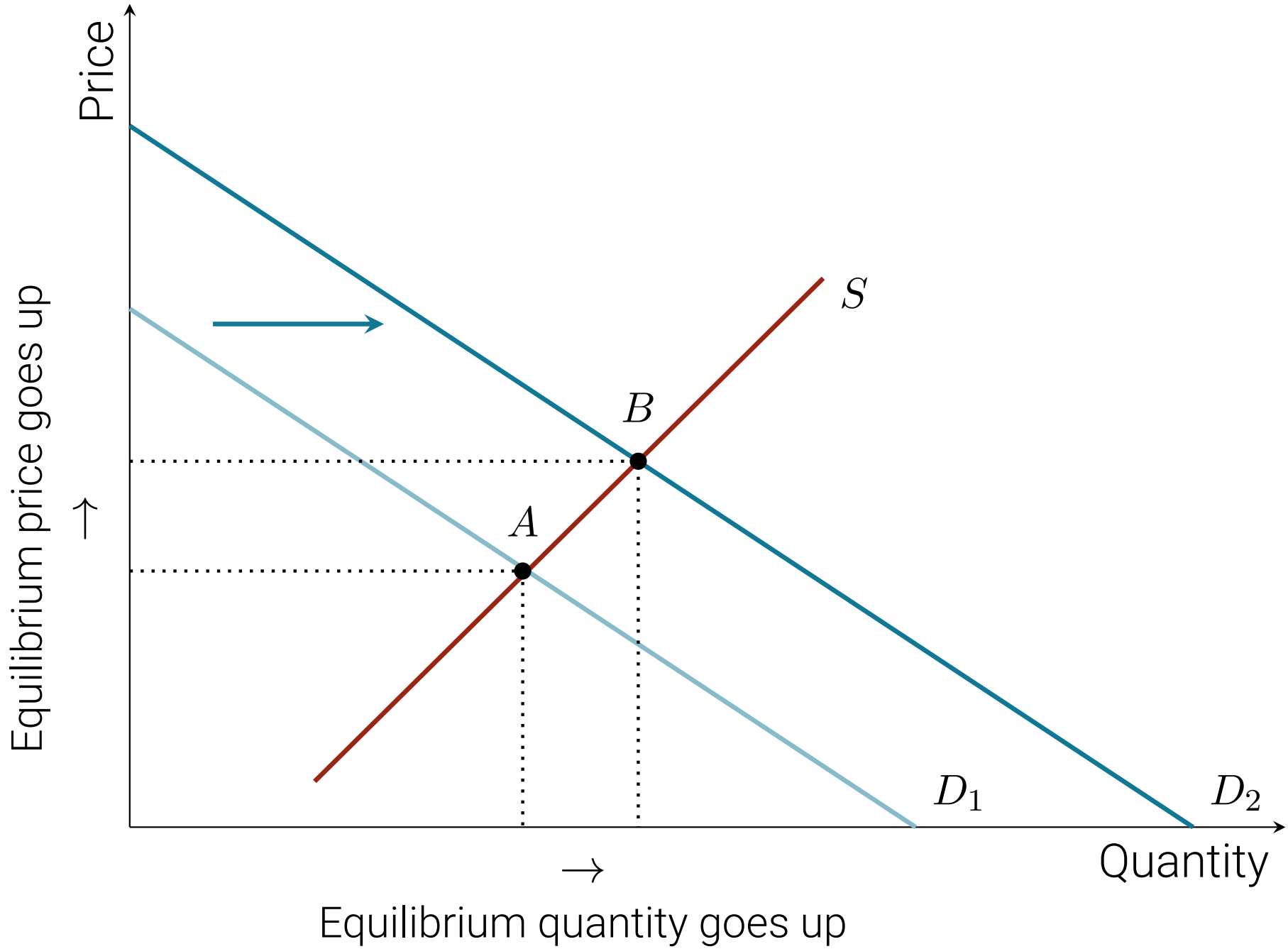
- This causes the demand curve to shift to the right.
- The price will rise, and the quantity sold will rise.
- Other causes of a demand shift are changes in preferences, the number of consumers, and expectations.


Price
Equilibrium price goes up
$\rightarrow$
S
B
A
D_1
D_2
Quantity
$\rightarrow$
Equilibrium quantity goes up

Shifts in Supply and Demand

Suppose now that the price of labor increases. *What happens to the supply curve?*

Shifts in Supply and Demand

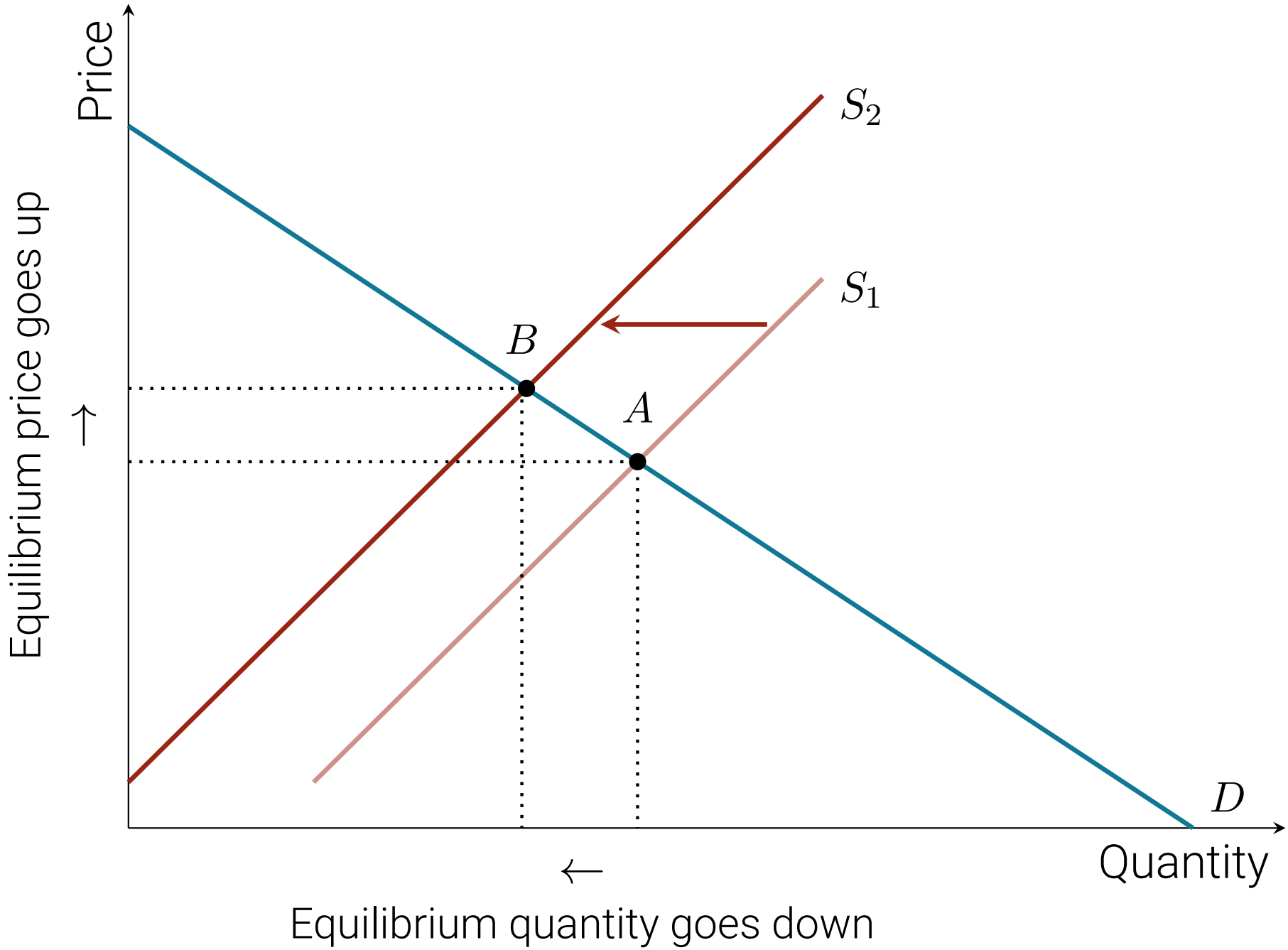
Suppose now that the price of labor increases.

- This causes the supply curve to shift to the left.

Shifts in Supply and Demand

Suppose now that the price of labor increases.

- This causes the supply curve to shift to the left.
- Price increases and quantity sold decreases.
- Other causes of a supply shift are changes in technology, input prices, number of suppliers, and expectations.


Price
Equilibrium price goes up
S_2
S_1
B
A
D
Quantity
Equilibrium quantity goes down

Shifts in Supply and Demand

What if *both* curves shift simultaneously? Suppose, for example that demand increases but supply decreases.

- Both of these shifts result in a higher price.
- But they pull the equilibrium quantity in opposite directions
- We need to know the magnitude to know which direction quantity moves.

Try It Yourself

Sketch a decrease in supply and an increase in demand where quantity goes up. Sketch a decrease in supply and an increase in demand where quantity goes down.

Shifts in Supply and Demand

In general, when both curves shift, the change in either price or quantity will be obvious...

- ...but not both.
- One of these will always be ambiguous. Need to know magnitude of shifts.

Shifts in Supply and Demand

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- ...but not both.
- One of these will always be ambiguous. Need to know magnitude of shifts.

Us professors love to ask questions on this. **When in doubt, draw it out!**

Price Elasticity of Demand

Let’s say your boss asks you what will happen to sales if they increase the price of their product. Don’t you dare say “sales will go down”. *duh!!*

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This is the **price elasticity of demand**

Price Elasticity of Demand

Price elasticity of demand

Measures the sensitivity of the quantity demanded to changes in the price.

$$\epsilon_{Q,P} = \frac{\text{percentage change in quantity}}{\text{percentage change in price}}$$

Price Elasticity of Demand

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Remembering our percent change formula

$$\epsilon_{Q,P} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = \frac{\Delta Q}{\Delta P}\frac{P}{Q}$$

Classifying the Price Elasticity of Demand

Value of $\epsilon_{Q,P}$	Classification	Meaning
$\epsilon_{Q,P} = 0$	Perfectly inelastic demand	Quantity demanded is completely insensitive to price
$-1 < \epsilon_{Q,P} < 0$	Inelastic demand	Quantity demanded is relatively insensitive to price
$\epsilon_{Q,P} = -1$	Unitary elastic demand	Percentage increase in quantity demanded is equal to percentage decrease in price
$-\infty < \epsilon_{Q,P} < -1$	Elastic demand	Quantity demanded is relatively sensitive to price
$\epsilon_{Q,P} = -\infty$	Perfectly elastic demand	Any increase in price results in quantity demanded decreasing to zero, and any decrease in price results in quantity demanded increasing to infinity

Calculating Elasticity

Try It Yourself

Suppose that when the price of car tires is $100 per tire, quantity demanded in Detroit is 40,000. Now suppose that the price has fallen to $90, and the quantity demanded is 50,000. What is the price elasticy of demand?

Interpreting Elasticities

$$\epsilon_{Q,P} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}}$$

A 1% increase in price yields a $\epsilon_{Q,P}$% change in quantity.

Interpreting Elasticities

$$\epsilon = \frac{\frac{\Delta \text{Top Thing}}{\text{Top Thing}}}{\frac{\Delta \text{Bottom Thing}}{\text{Bottom Thing}}}$$

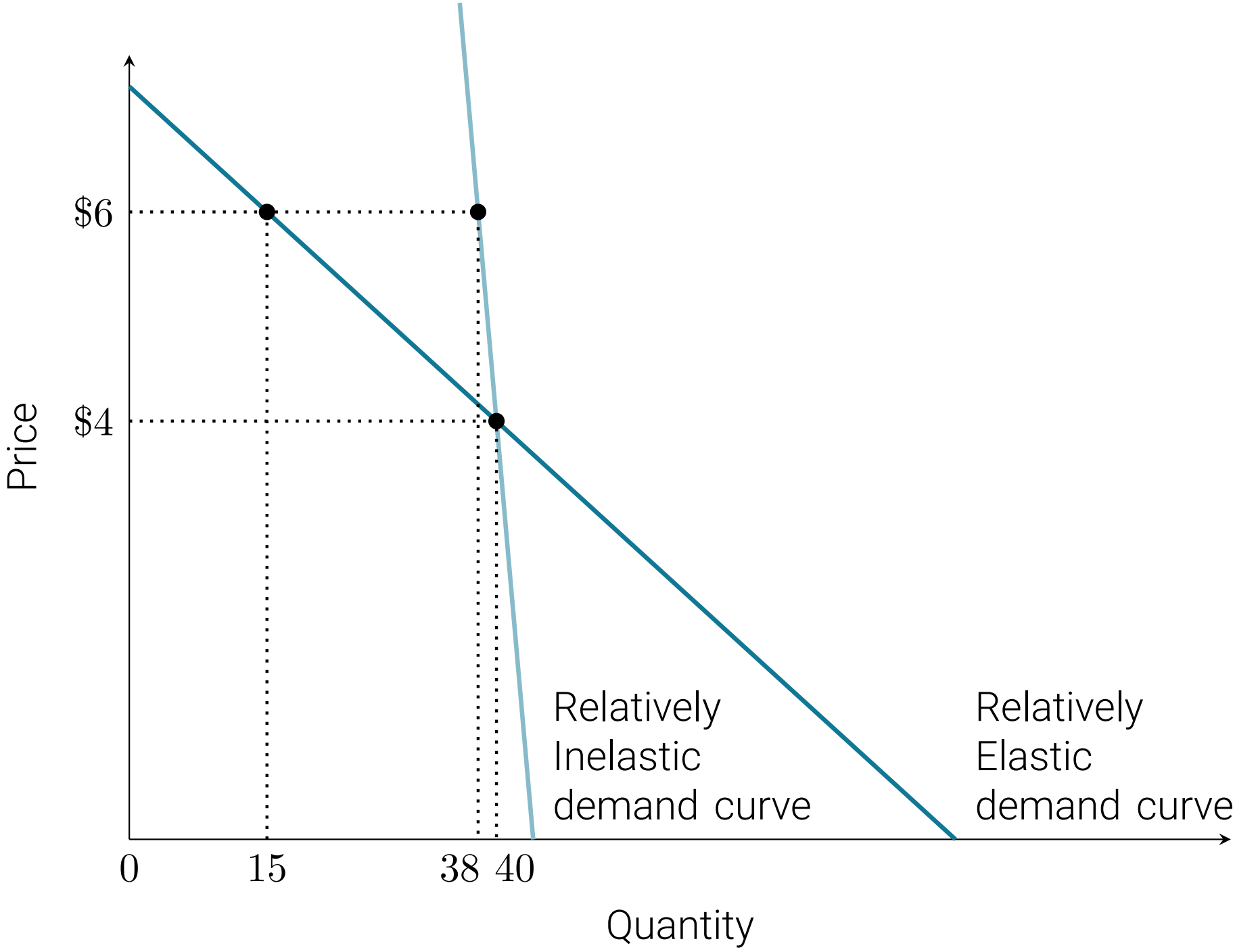
More generally, the way we *always* interpret elasticities is:

A 1% increase in Bottom Thing yields a ϵ% change in Top Thing

Calculating Elasticity

There's all kinds of elasticities we care about in economics.

- The government might care what the price elasticity of demand is for cigarettes if they want to impose a tax.
- Or they might want to know what the cross-price elasticity of demand is for electric vehicles with respect to the price of gas.
- And if the government does impose some tax... firms might want to know how much of that tax they can pass on to consumers via higher prices.


Price
$6
$4
0
15
38
40
Quantity
Relatively
Inelastic
demand curve
Relatively
Elastic
demand curve

Income elasticity of demand

% change in quantity demanded for every 1% change in income.

$$\epsilon_{Q,I} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta I}{I}} = \frac{\Delta Q}{\Delta I}\frac{I}{Q}$$

Price elasticity of supply

% change in quantity supplied for every 1% change in price of good.

$$\epsilon_{Q^S,P} = \frac{\frac{\Delta Q^s}{Q^s}}{\frac{\Delta P}{P}} = \frac{\Delta Q^s}{\Delta P}\frac{P}{Q^s}$$

Cross-price elasticity of demand

% change in quantity demanded of good i for every 1% change in price of good j.

$$\epsilon_{Q_i,P_j} = \frac{\frac{\Delta Q_i}{Q_i}}{\frac{\Delta P_j}{P_j}} = \frac{\Delta Q_i}{\Delta P_j}\frac{P_j}{Q_i}$$

Cross-price elasticity of demand

% change in quantity demanded of good i for every 1% change in price of good j.

$$\epsilon_{Q_i,P_j} = \frac{\frac{\Delta Q_i}{Q_i}}{\frac{\Delta P_j}{P_j}} = \frac{\Delta Q_i}{\Delta P_j}\frac{P_j}{Q_i}$$

If $\epsilon_{Q_i,P_j} > 0$, then as P_j increases, Q_i increases.

- Then goods i and j are **substitutes**.

Cross-price elasticity of demand

% change in quantity demanded of good i for every 1% change in price of good j.

$$\epsilon_{Q_i,P_j} = \frac{\frac{\Delta Q_i}{Q_i}}{\frac{\Delta P_j}{P_j}} = \frac{\Delta Q_i}{\Delta P_j}\frac{P_j}{Q_i}$$

If $\epsilon_{Q_i,P_j} > 0$, then as P_j increases, Q_i increases.

- Then goods i and j are **substitutes**.

If $\epsilon_{Q_i,P_j} < 0$, then as P_j increases, Q_i decreases.

- Then goods i and j are **compliments**.

Elasticity in the Long Run vs. the Short Run

Consumers can't always adjust their demand instantly in response to a price change.

- If the price of gasoline doubles, you still have to drive to work.
- But after a while, maybe you will buy a more fuel-efficient car.

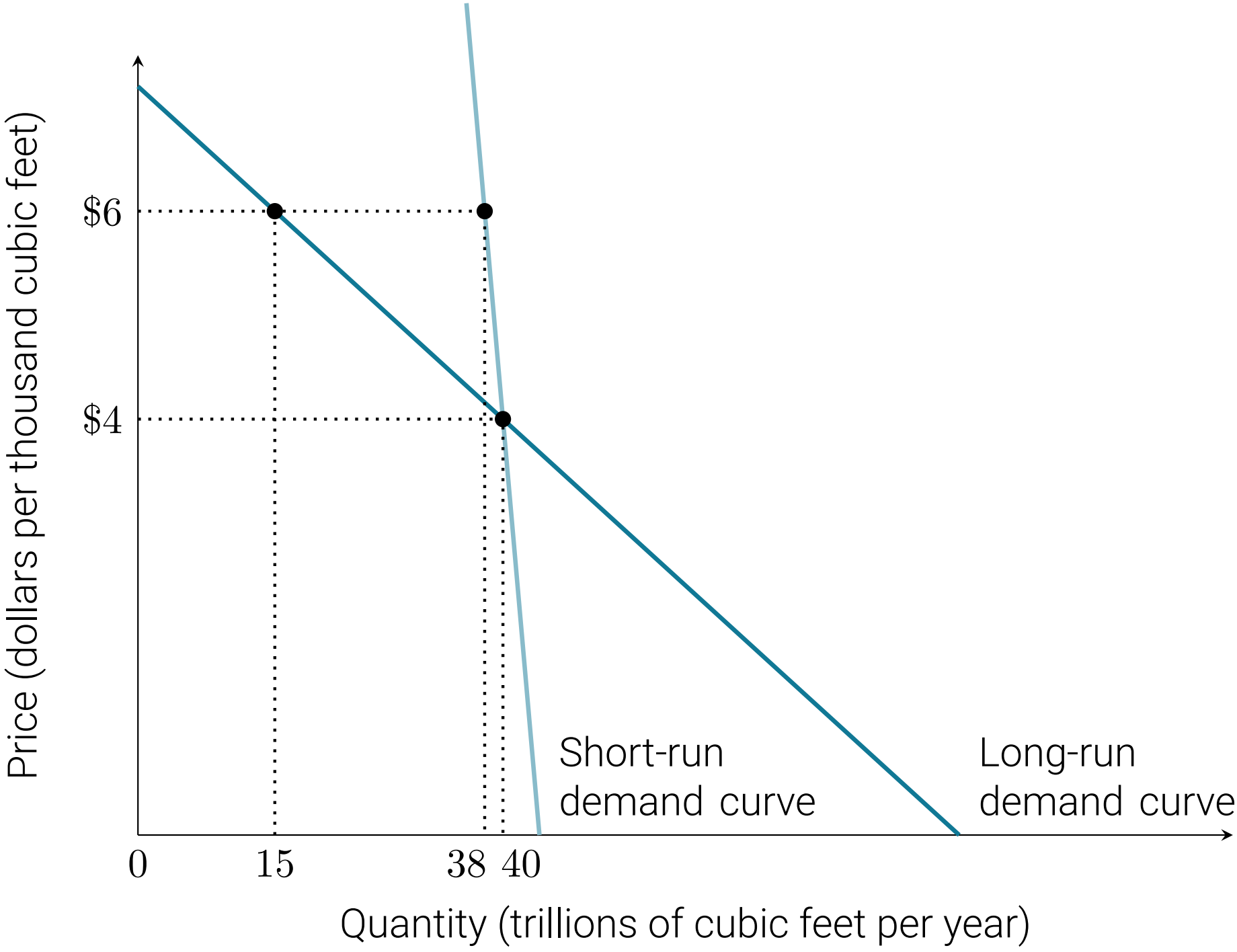
Elasticity in the Long Run vs. the Short Run

Consumers can't always adjust their demand instantly in response to a price change.

- If the price of gasoline doubles, you still have to drive to work.
- But after a while, maybe you will buy a more fuel-efficient car.

Need to distinguish between **long-run demand curve** and **short-run demand curve**.

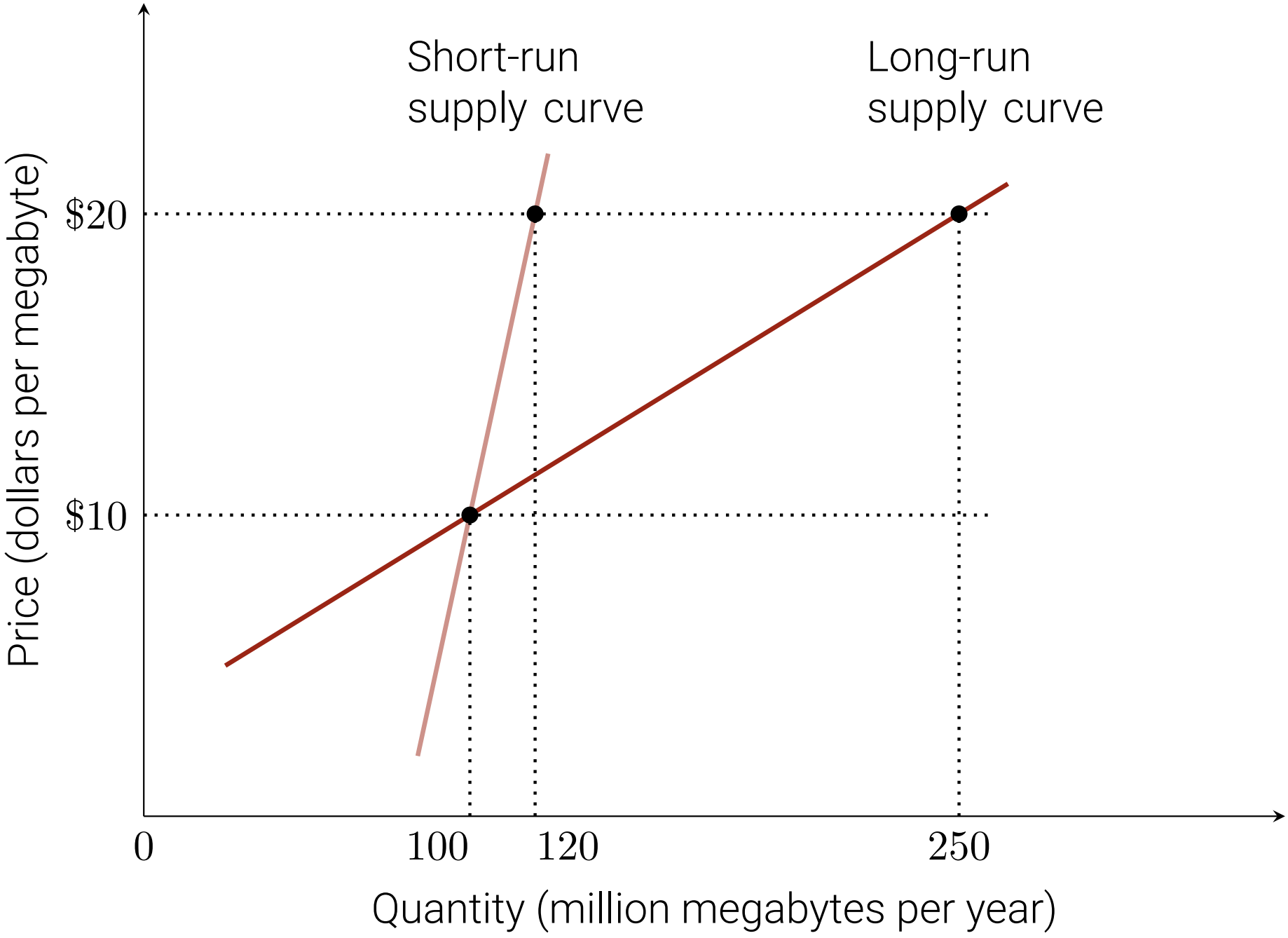
- Long run - Consumers have time to fully adjust purchasing decisions.
- Short run - Consumers do not.


Price (dollars per thousand cubic feet)
$6
$4
0
15
38
40
Short-run
demand curve
Long-run
demand curve
Quantity (trillions of cubic feet per year)

Elasticity in the Long Run vs. the Short Run

The same is true for producers

- May not be able to increase output quickly in response to a price increase. Perhaps they are capacity-constrained.
- But in the long run, they can build another factory, or hire more workers. And quantity supplied increases.


Short-run
supply curve
Long-run
supply curve
Price (dollars per megabyte)
$20
$10
0
100
120
250
Quantity (million megabytes per year)

Elasticity in the Long Run vs. the Short Run

In some cases however, the opposite may be true.

If price falls for durable goods such as a new refrigerator, consumers may decide it's a good time to upgrade their old one.

- But in the end, they don't buy *more* refrigerators. They just buy them sooner.
- In this case, demand is more elastic in the short run

The same may be true of producers (such as in markets for used or recycled goods).